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ABSTRACT

As part of a long-range information systems planning effort at the University of Miami, the impact of technology on the organization was assessed. The assessment covered hardware, office automation, systems and database software, and communications. The trends in computer hardware point toward continued decreasing size and cost, placing computer power at the closest point to human interaction. The explosion of personal computing is threatening to overshadow office automation as a unique discipline. Movements toward greater flexibility in mainframe databases, and the emergence of strong high level development tools appears to be stimulating a resurgence of custom-developed software in many institutions of higher learning. The University of Miami has recognized three interdependent arenas for automation: (1) the institutional level, based on mainframe technology, allows for the highest level of data sharing in a centralized database network; (2) the local level provides for contained data sharing within departments or operating units; and (3) the personal level allows dedicated manipulation of shared data and the proper environment for unshared data. A schematic of the overall institutional processing architecture, which represents the three-tiered approach, is included. (SW)

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IMPACT OF TECHNOLOGY ON THE UNIVERSITY OF MIAMI

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ABSTRACT

While it is difficult in any rapidly changing environment to predict five years into the future, it is possible to detect trends and extrapolate their effect on the organization. Much of the technology that will be commercially available in the future already exists in experimental form today. With proper research and intelligence, it is possible to make a reasonable estimate of the trends within the planning horizon. As a part of a long range information systems planning effort, an assessment of the impact of technology on the organization was developed. This paper shows the trends identified and suggests the anticipated impact on the University of Miami.

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INTRODUCTION

The University of Miami is a private, independent, nonsectarian university which was chartered in 1925 as a nonprofit institution of learning, whose policies are established by a self-perpetuating Board of Trustees. The University serves approximately 20,000 credit and non-credit students each year. The Information Systems & Planning organization supplies the information, services and facilities needed by the University to support its institutional objectives, along with providing staff support to the President as the chief planning unit. The following are the Information Systems & Planning organization's major objectives:

- Plan and coordinate an environment to store and safeguard the computerized official records of the University
- Plan, approve, and/or develop the automated applications necessary to collect, maintain, and display computerized official University records
- Provide planning, consulting, advising, and facilitating services to the University community for the acquisition of computer hardware, software, and the development of procedures
- Plan, coordinate, and approve the hardware environment to support university-wide computing needs
- Provide the production environment necessary to support the processing of shared official records in the university-wide information architecture

In October, 1983 the University of Miami published a plan to address its information systems requirements for the ensuing 5-7 years. The Long Range Information Systems Plan that resulted took four calendar months and approximately four effort-years to complete. This paper summarizes the Plan's findings concerning technological issues.

TECHNOLOGICAL TRENDS IN COMPONENTS

In order to assess the overall impact of developments in

technology, it is necessary to examine the trends within the major components that comprise any modern information system. These components are: hardware, office automation, systems and data base software, and communications.

HARDWARE TECHNOLOGY

The most significant trend in computer hardware technology is the continued reduction in physical dimensions and cost. The computer industry's astounding progress has made it both physically and economically desireable to place computer hardware as close as possible to the human/machine interface point. We now see computers in watches, televisions, electronic organs, automobiles, microwave ovens and a diverse spectrum of other consumer goods. More importantly for information processing, the cost/size reductions have made the personal workstation a reality.

Large shared mainframe computers are becoming specialized in the handling of massive data sharing requirements, and soon will leave the preponderance of data manipulation and interactive tasks in the realm of the minicomputer and microcomputer. Mainframes are, of course, also benefitting from continued improvements in integrated circuit density as the processor becomes less and less conspicuous in computer rooms of today. Higher densities will also continue to expand the capacity of data storage devices yielding improved tape, disk, and optical storage capacities.

Minicomputers are more capable than ever before with a steady migration towards larger word sizes and increased speed. The same is true of microcomputers and personal computers. The potential market for these devices is offering financial incentives for ingenuity which is spurring an exponential growth of technology. The availability of significant storage capacity, such as fixed disk on the larger personal computers, is showing the way to new horizons in information processing. The work being done to refine the human/machine interface with color graphics, touch sensitive screens, voice synthesis and voice recognition will help small computers to be accepted by even the most reluctant users. To further stimulate the race towards personalization in information processing, all of these qualities will be available in portable models which adds another facet to their popularity.

OFFICE AUTOMATION

The purpose of office automation is to improve the performance of the business operations of an organization. As it has turned out, office automation has been a fascinating experiment in the computerization of administrative record keeping and document production tasks. However, office automation is now being

accepted as a subset of information processing, and the delineations between the two are becoming less and less clear. As originally introduced, stand alone word processing units were viewed as a boon to office productivity, even though they did not necessarily improve overall business performance. It is now recognized that effective office automation requires the sharing of resources among both local and institutional users for the business mission to be pursued more effectively. The desireability of access to larger data bases for basic standard information is forcing office automation and information processing together in order to reduce the cost of information handling.

Stand alone word processing has become a modern controversy. The most significant contrasts between personal computing and word processing have been the dedicated software used for word processing and the customized keyboard arrangement. Word processing keyboards and software were designed in tandem towards optimized document production activities. A significant movement towards the use of more generalized machinery, such as microcomputers, for word processing is underway through the availability of specialized document-oriented keyboards and software. As a unique discipline and information architecture component, office automation will probably be engulfed by personal and office computerization in general.

SYSTEMS & DATA BASE SOFTWARE

The most exciting developments in this component are the continued improvements being offered in flexible mainframe data base software and application development aids. Major software forces have released powerful software which combines the high volume efficiency of a structured network with the capability of relational views within the data base. Cullinet's IDMS/R and IBM's recently announced DB2 are just two examples. High level languages are yielding fantastic returns in productivity with online transaction, query, and report writer languages. The power of data base is also available on minicomputer and microcomputer systems which is making data manipulation at this level extremely cost effective when contrasted with mainframe costs.

The inability to segment the institutional data base is currently one of the major obstacles to the totally effective use of small computer systems. There is still a need to physically locate institutionally shared data in the central environment, even though application programs may effectively reside at decentralized sites. There are current developments underway which show promise in allowing the creation of a single large logical data base which can been physically decentralized according to tuning parameters. The importance of this development will be to allow the physical and logical networking

of smaller systems into a single large shared data environment. Along these lines, several vendors are offering mainframe integration software for minicomputers and microcomputers which will allow simplified access for upload and download data movement tasks.

COMMUNICATIONS

With the popularity of small systems, and recognizing the need for an institutional shared data base, effective communications takes on more importance than ever before. The recent movement towards combined voice and data transmission is the logical choice for today's information architect. This technology allows the basic communication system to operate in digital mode. Onto this system, voice is digitized at the transmitting instrument via a coder/decoder (CODEC) and decoded by the receiving device. The capacity for providing computer terminal access to the network at each telephone installation without a modem is opening new horizons in information systems design. Each computer which is connected to the network becomes a potential host, which can allow more effective use of computer resources for institutions with multiple computer sites.

Special interest networks, such as EDUNET and Dow Jones, allow access by subscribers with similar or specialized interests. Other specialized networks are useful for meeting the needs of those users who require unusual or extremely powerful computing not available locally. With the availability of electronic input to typesetting equipment, the transmission of large quantities of data for upload, download, and special printing, the increased transmission of video signals, and the proliferation of computing devices operating at higher speeds is placing an increasing load on communications facilities. Planning today should allow for the tremendous upsurge in traffic anticipated within the next few years.

ARCHITECTURES - PUTTING TOGETHER THE COMPONENTS

Having examined the component technology, it is difficult to bring a complete picture into focus. The tendency is to use one of the components as a basis for information systems design. For example, it may be convenient to consider hardware as the basis for an overall institutional design, but this can be misleading. When considering mainframe hardware, it is difficult to contemplate multiple processor configurations which effectively form a single unit. The University of Miami has recognized the need to share information among operating units as the basis for design. Based upon an extrapolation of the trends in each of the

major components: hardware, office automation, systems and data base software, and telecommunications, the University of Miami formulated a global information processing architecture. This overall institutional architecture, as depicted in the Appendix, represents a three tiered approach which is defined in terms of the level of sharing required: institutional, local, and personal.

INSTITUTIONAL LEVEL

The cost-effective need to share information, services, and facilities is the rationale for investment in a central facility. The central facility forms the highest level of sharing for the University of Miami. Allowing connection of minicomputers, word processors, personal computers, and terminals, the central facility will form a bridge of commonality. The University of Miami's institutional level facility will remain based upon medium-sized mainframe technology for the forseeable future. Although referred to as "central", the facility may include more than one mainframe, located appropriately. The high volume of information resident in the central facility will be concentrated in a production oriented data base structure. Control over the integrity of the data base will be the responsibility of the Information Systems organization. In contrast, the responsibility for the contents of the data base will be diffused among defined organizational units. The main data base, voluminous and highly shared, will need to be structured for efficiency. Centrally developed applications will facilitate routine data base access, inquiry, and update. Other uses of the information will be fostered through the development of software "delivery systems" which will transfer subsets of information outside the central data base environment for further analysis at the user's site.

The trend in application software has been towards streamlining the system development process through application generators and report generators (referred to as fourth generation languages). These aids are generally integrated with the data base management system. The availability of such development aids encourages the use of innovative design techniques, such as prototyping. A prototype is a model of an application system which can assist the user in clarifying requirements before a large investment is made in the finished product. Using these techniques, user involvement is high, tangible results are rapid, and overall programming and documentation efforts are reduced.

All of the trends in technology and the information requirements of the University of Miami emphasize the need for an institutional level shared facility. By allowing for university-wide sharing of information and resources, the University can anticipate much greater synchronization of its operating administrative units.

SHARED LOCAL LEVEL

Typically based on minicomputer and microcomputer hardware, shared local systems are characterized by shared data, applications, and resources, usually at the operating unit or department level. Quite often storage is shared, and the processing units may also be shared. Since shared local systems use various communications protocols within their local networks, communication with other local or central systems frequently requires protocol conversion. Many of the available configurations offer protocol conversion to enable local terminals to easily act as members of the institutional level facility. Shared local installations are technically sophisticated and require skilled local operational management. Data are shared at a local level only, using file or data base capabilities. The data structures need not be as highly performance oriented as those of the institutional facility, and can therefore offer greater flexibility. The sponsoring operating unit or department must have responsibility for data integrity, control, backup, recovery, disaster planning, and data validity.

The shared local system is characterized by the use of application software packages. The applications, and therefore the shared systems, cannot be justified when a majority of the information is of material value to others within the University's administration. A useful rule of thumb for judging the applicability of an application for this architecture is the "80/20 Rule". This states that if 80% of an application's data is of local interest only, and conversely, that no more than 20% is of general interest to the University's administration, the application is a candidate for the shared local architecture. Applications which require basic identification data, such as name and address, to be downloaded, and generate financial transactions to be uploaded, generally fall within this definition.

PERSONAL LEVEL

With the advent and popularity of affordable desktop systems, the personal computer has become an important component of the University of Miami's information architecture planning. Personal systems are based on microcomputer technology. Capable of emulating various terminal protocols, when contrasted with unintelligent terminals they can offer significant expansion of capabilities for small incremental cost. For example, each can operate as a stand-alone system, function as a component of a shared local system, or connect via communications to other networks, including the shared institutional facility. This flexibility will lead towards overwhelming popularity.

The movement towards personal computer systems at the University of Miami will be assisted through the availability of training and consulting services. However, the responsibilities of the owner include data control, validity, integrity, backup, recovery, privacy, and security. When connected to a network, including the institutional level facility, the responsibilities become similar to those of other terminals in the network.

Because of the relatively low cost, excess computer capacity can often be justifiable at the personal level. Data structures tend to exploit this fact by encouraging extreme flexibility. This flexibility highlights the personal systems as an excellent means for data analysis. In contrast to the central data base environment, practical software packages proliferate for the personal computer market. These packages are generally friendly and well documented.

At this point in time, it appears that personal computer systems will be most useful in receiving subsets of data from the main data base and further analyzing the information to produce graphics and special reports. The data subsets may also be used in various modeling systems. Additionally, personal systems will aid in maintaining many forms of unshared data which would not be of interest to others. At the University of Miami, the personal level system will be included as an integral component in the university-wide system application design process.

SUMMARY

Examining the trends in the component technologies provides the basis for structuring an omnibus architecture to meet the demands of the next decade of information processing. The trends in computer hardware point towards continued decreasing size and cost, placing computer power at the closest point to human interaction, with great strides underway to make this interface point less intimidating to the uninitiated. The explosion of personal computing is threatening to overshadow office automation as a unique discipline.

Movements towards greater flexibility in mainframe data bases, and the emergence of strong high level development tools appears to be stimulating a resurgence of custom-developed software in many institutions of higher learning. This, coupled with personal computing calls for extreme conservatism in today's communications planning.

Putting the pieces together, the institutional data view is an effective way to organize the components. The University of

Miami has recognized three interdependent arenas for automation. The Institutional Level, based on mainframe technology, allows for the highest level of data sharing in a centralized data base network. The Local Level provides for contained data sharing within departments or operating units, while the Personal Level allows dedicated manipulation of shared data and the proper environment for unshared data.

PROCESSING ARCHITECTURE SCHEMATIC